SECRET

ENG-6-399

Chief, Supplemental Programs Division, OC 9 April 1956
ATTN : Chief, ELINT Activities Branch
Chief, Engineering Division, OC

[redacted] 25X1

REF : Memorandum to Chief, OC-E from Chief, SP/EA dated 1 November 1955 (SP/EA-5-236).

1. This memorandum forwards the [redacted] 25X1
[redacted] General characteristics and operating instructions are 25X1
attached. Photographs, which show the equipment in various stages of assembly, are in process and will be forwarded within a few days.

2. The attached information is intended only to satisfy installation and operational requirements. A detailed report will be prepared which will provide your office with a comprehensive summary of the experience gained in the development of this system. The functional characteristics of the various system components will also be included in greater detail. It is anticipated that the report will be ready in about three weeks.

3. In order to cover possible failure during pre-installation testing, spare video and audio amplifiers are being packaged. These units are scheduled to be complete in about one week; however, they could be made available in two days on a "crash" basis. With the exception of coils and chokes, the Laboratory has on hand 100% component spares. All other materials used in the construction of the system, or required in the preparation [redacted] non- 25X1
conductive paints excepted, are in stock.

4. One of the more persistent problems encountered during the development of this system was that of reducing the motor noise to an acceptable level. Effects of the noise can be eliminated, for all practical purposes, when the system is assembled in the open; however, a considerable increase occurs with assembly inside the copper housing. Substantial improvement was made during the last few days through rearrangement of the shielding and by-passing configurations. However, the present noise level is still not considered to be optimum; but it appears that further significant reduction can be accomplished only after careful study of mock-up assemblies which would be time consuming to the point of jeopardizing present operational schedules.

R. B. BLACKBURN

Attachment:
System Characteristics and Operating Instructions

R&D/Lab/NCP/jcm (7 April 1956)
Distribution: Original and 1 - Addressee, 1 - R&D Lab, 1 - R&D Chrono,

SYSTEM CHARACTERISTICS AND OPERATING INSTRUCTIONS

1. General

The system consists of a microwave crystal video receiver, a wire recorder, and a demand and timing circuit. When illuminated by RF, the demand circuit starts the recorder and applies the signal to the recording head. The timing device allows the signal to be recorded for five minutes after which it shuts down the system to await the next signal.

2. RF Response

Figure 1 shows the frequency response of the crystal detector mount. Tangential sensitivity, (the power required to raise the noise on an oscilloscope by its own height), is plotted. This data shows that the detector is sensitive up to 10 Kmc.

Figure 2 shows how the gain of the antenna varies with frequency. The low frequency cut-off should be at 1.5 Kmc. The antenna has acceptable gain at 2 Kmc and a much higher gain at 10 Kmc. However, the high gain at high frequencies must be paid for by a decrease in horizontal beam width as is shown in figure 3.

In general, the RF response is acceptable over the 2 to 10 Kmc range; it is limited at the low frequency end by the antenna and at the high frequency end by the detector mount.

3. Pulse Response

The relative RF response as a function of pulse width and repetition frequency is plotted in figure 4. Pulse response holds fairly well down to 1 or 2 microseconds.

4. Motor Speed

Figure 5 shows the speed in RPM of the take up spool of each recording motor as a function of motor voltage. These motors are extremely well regulated and governed to have a speed, and therefore, a frequency calibration, that is accurate to within five per cent for supply voltages ranging between 7 to 10 volts.

5. Overall Operation

The complete circuit diagram for the unit is shown in figure 6. The operation is as follows:

a. A microwave pulse enters the antenna and is detected by the 1N26 crystal.

b. This pulse is amplified by the video amplifier, and then stretched into an audio pulse by the 1N67 pulse stretcher.

c. The audio pulse is further amplified to the level required to activate the demand and timing circuit.

d. Initially, relays 3 and 4 are relaxed so the pulse feeds into the 2N57 power transistor and closes relay 1-2. This relay is self locking through the closing of contacts 1. The closing of contacts 2 energizes the coils of relays 3 and 4 and activates the timing and recording motors.

e. As relay 4 is energized, its contacts apply the signal to the recording head.

f. Sw-1 is connected to a cam on the five minute timing motor. After about twenty seconds, this cam moves Sw-1 from the position shown on the diagram. This de-energizes relay 1-2 but leaves relays 3 and 4 and the motors still grounded.

g. Recording continues and the timing motor continues to turn until it comes back to its original position. At this time the cam on the timing motor moves Sw-1 back to the position shown on the diagram which de-energizes relays 3 and 4 and the motors.

h. Relays 3 and 4 relax leaving the circuit sensitive to a new signal. The time for relay 3 to relax is long enough to prevent retriggering from transient currents associated with switching off the motors.

6. Operating Instructions

a. Turn the ON-OFF switch, which is located on the bottom of the unit, into the OFF position. THE OFF POSITION IS FULL COUNTERCLOCKWISE ROTATION.

b. Insert the battery pack, the recording head, and motor.

c. Turn the ON-OFF switch into the ON position. The unit is now ready to operate.

7. Sensitivity Adjustment

The demand sensitivity of the unit can be adjusted. Ideally this adjustment should be made so that the unit is as sensitive as possible without triggering spontaneously from noise.

The adjustment is made with R23 which is shown on figures 6 and 7. CLOCKWISE ROTATION of the potentiometer increases the sensitivity. The procedure is as follows:

a. Remove all RF interference by placing a metal shield over the front of the antenna.

b. Rotate R23 clockwise from the fully counterclockwise position until the unit triggers spontaneously from noise.

c. Rotate R23 slightly counterclockwise until excessive spontaneous triggering ceases.

8. Standby Time

The system standby capabilities are based on the following data:

a. Standby current drain: 3 ma

b. Recorder spool capacity: 4 hours

c. Recording current drain: 100 ma

d. Battery capacity (nominal): 1 ampere-hour

e. Consumption during 4 hours recording: 0.5 ampere-hour

f. Available for standby operation: 0.5 ampere-hour

g. Standby time at 3 ma rate: 167 hours (approximately 1 week)

9. [redacted] 25X1

10. **Silvercel Batteries**

In addition to the attached manufacturer's data sheets, the following information is presented as a guide to the proper storage and handling of the Silvercel batteries.

a. Ideal storage conditions for the Silvercel exist when stored in the dry state at minus 20°F. Under these conditions, the cells can be satisfactorily stored for an indefinite period.

b. After electrolyte has been added, the optimum condition of storage is in the fully charged state. However, the manufacturer indicates that the cells can be safely stored at any intermediate state of charge, and at any temperature from minus 40°F to plus 100°F, for a period of at least six months. Long time storage at temperatures below minus 40°F will reduce cell efficiency but it will not destroy the cell. At temperatures above plus 100°F the effects of self discharge become evident. For example, at 135°F the cell will discharge 25% in four weeks. At 165°F full discharge occurs in two weeks.

c. Six battery packs are supplied with the system. These batteries are in the fully charged condition.

11. Assembly Instructions

An access port has been provided for the removal of the battery pack and the recorder unit. Unless it is absolutely necessary, the system should not be further disassembled. In the event disassembly becomes necessary, or for guidance in final removal, the following step sequence should prove useful:

a. Remove filter.
b. Remove #4-40 screw under bracket.
c. Remove battery compartment access port cover.
d. Remove battery package and recorder unit.
e. Disconnect antenna connector at the antenna.
f. Uncouple video amplifier connector.
g. Remove the two hold-down nuts from the battery and recorder socket bracket.
h. Raise the bracket and place on top of antenna. Care should be exercised so as not to twist or damage the cable.
i. [redacted] 25X1
j. Remove the two antenna hold-down nuts.
k. Lift the antenna from the studs and withdraw to the rear.
l. [redacted] 25X1
m. Remove the three #10 screws which secure the assembly base plate.
n. Remove the base plate by bowing its center slightly downward and tilting forward until the on-off switch clears the lense housing.
o. The above procedure can be followed in reverse order upon reassembly. Note that during reassembly the hold down screws must be positioned prior to insertion of the respective component. Tape can be used for this purpose.
p. EXTREME CAUTION must be used in any soldering, brazing, or welding operation if damage to the copper encased semiconductor elements is to be avoided.
q. A NONCONDUCTIVE PAINT such as used in the preparation of radome surfaces, must be used [redacted] 25X1
25X1

COMPONENT LIST

SYMBOL	VALUE	FUNCTION
R1	3.9 meg	Bias
R2	30 k	Collector
R3	39 k	Collector
R4	3.3 meg	Bias
R5	20 k	Collector
R6	1.6 meg	Bias
R7	16 k	Collector
R8	39 k	Video dropping
R9	0 - 500 k ohm pot	Series input
R10	47 k	Series input
R11	.11 meg	Bias
R12	20 k	Stabilizing
R13	18 k	Collector
R14	3.9 k	Stabilizing
R15	68 k	Bias
R16	20 k	Stabilizing
R17	18 k	Collector
R18	3.9 k	Stabilizing
R19	47 k	Bias
R20	12 k	Stabilizing
R21	2.4 k	Stabilizing
R22	200 ohm, 1 watt	Current equalizing
R23	0 - 100 k pot	Sensitivity control
R24	39 ohm, 2 watt	Dropping resistor

All undesignated resistors are one-half watt.

C1	0.1 Mucon	Input coupling
C2	0.1 Mucon	Coupling
C3	0.1 Mucon	Coupling
C4	0.1 Mucon	Coupling
C5	0.1 Mucon	Coupling
C6	270 mmf mica	Pulse stretching
C7	0.1 Mucon	Coupling
C8	10 mf/25 v. tantalum	Bypass
C9	0.1 Mucon	Coupling
C10	10 mf/25 v. tantalum	Bypass
C11	10 mf/25 v. tantalum	Bypass
C12	175 mf/15 v. tantalum	Filter
C13	175 mf/15 v. tantalum	Filter
C14	175 mf/15 v. tantalum	Filter
C15	2 mf/100 v. tantalum	Pulse stretching
C16	100 mf/30 v. tantalum	Noise suppression
C17	100 mf/30 v. tantalum	Time lag
C18	10 mf/30 v. tantalum	filter

COMPONENT LIST

SYMBOL	VALUE	FUNCTION
T1	2,000 - 10,000 ohms (Argonne No. AR-109)	Record head output
T2	400 - 20,000 ohms (Argonne No. AR-105)	Driver
L1	60 mh 100 ma (Miller No. 693)	Motor noise choke
L2	150 mh 100 ma (Miller No. 961)	Motor noise choke
Relay 1-2	Coil resistance: 720 ohms Sensitivity: 150 mw (GE Microminiature)	Locking and Motor energizing
Relay 3	Coil resistance (dc): 2000 ohms Sensitivity: 100 mw (Elgin "Necmite" NM2k)	Transient suppression
Relay 4	Same as Relay 3	Audio switching
SW-1	(Microswitch 1SM1)	Time switch
SW-2	(Centralab rotary ceramic)	ON-OFF switch
M-1	(Haydon Series 9200) 6 v, 70 ma, 1/5 rpm	Timing motor
M-2	9 v at approx. 100 ma (MINIFON)	Recording motor

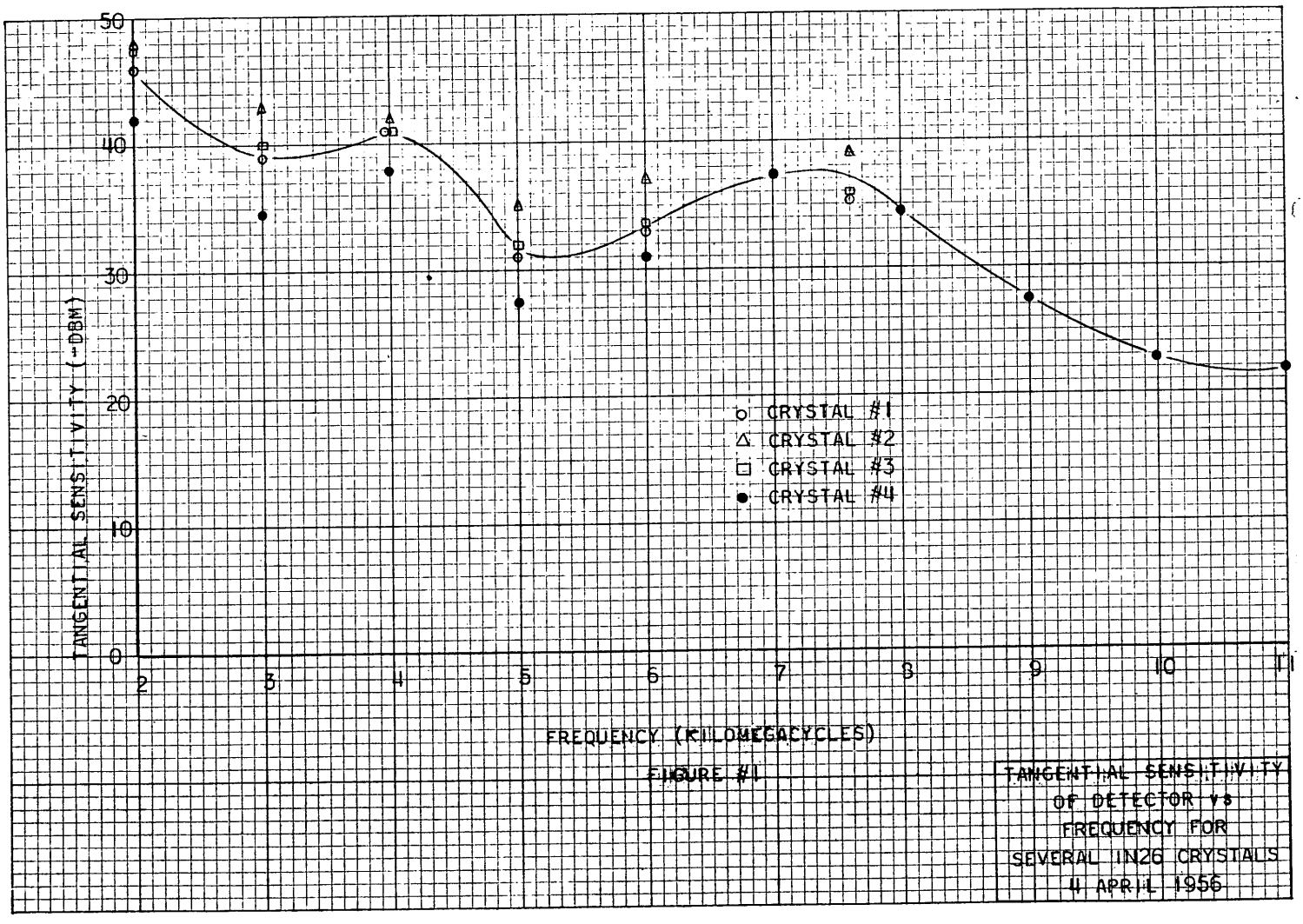

FIGURE #1

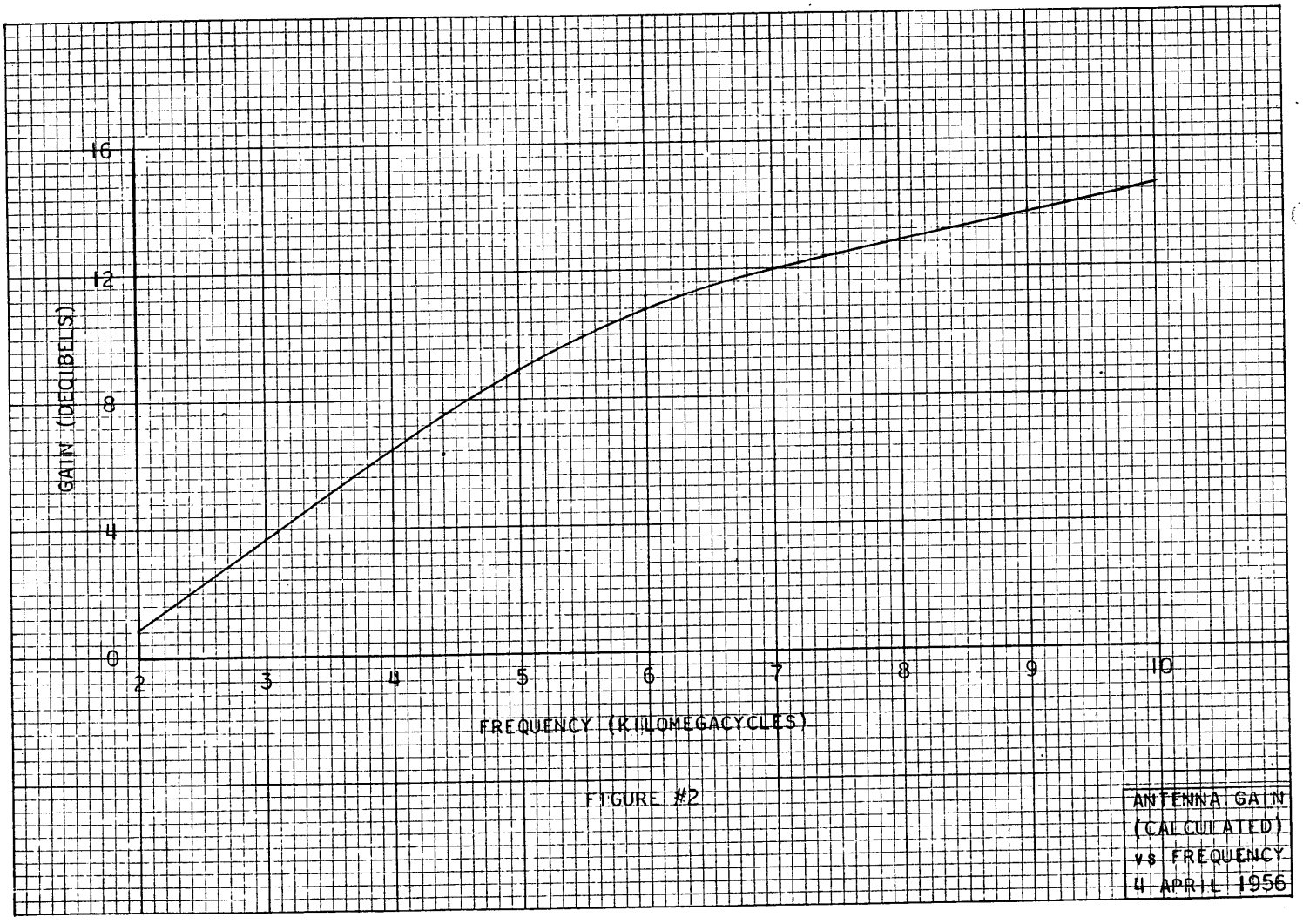

FIGURE #2

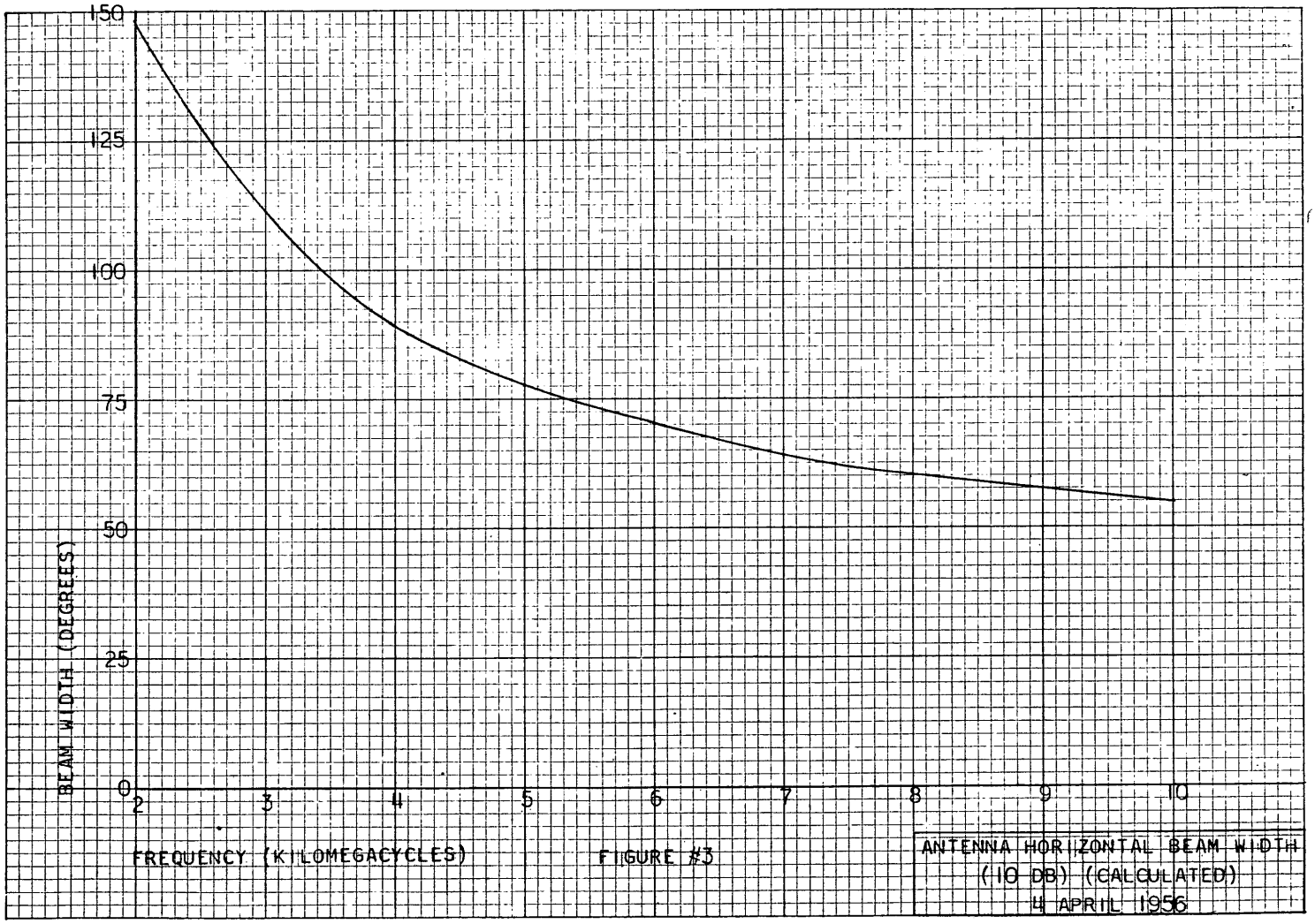

FIGURE #3

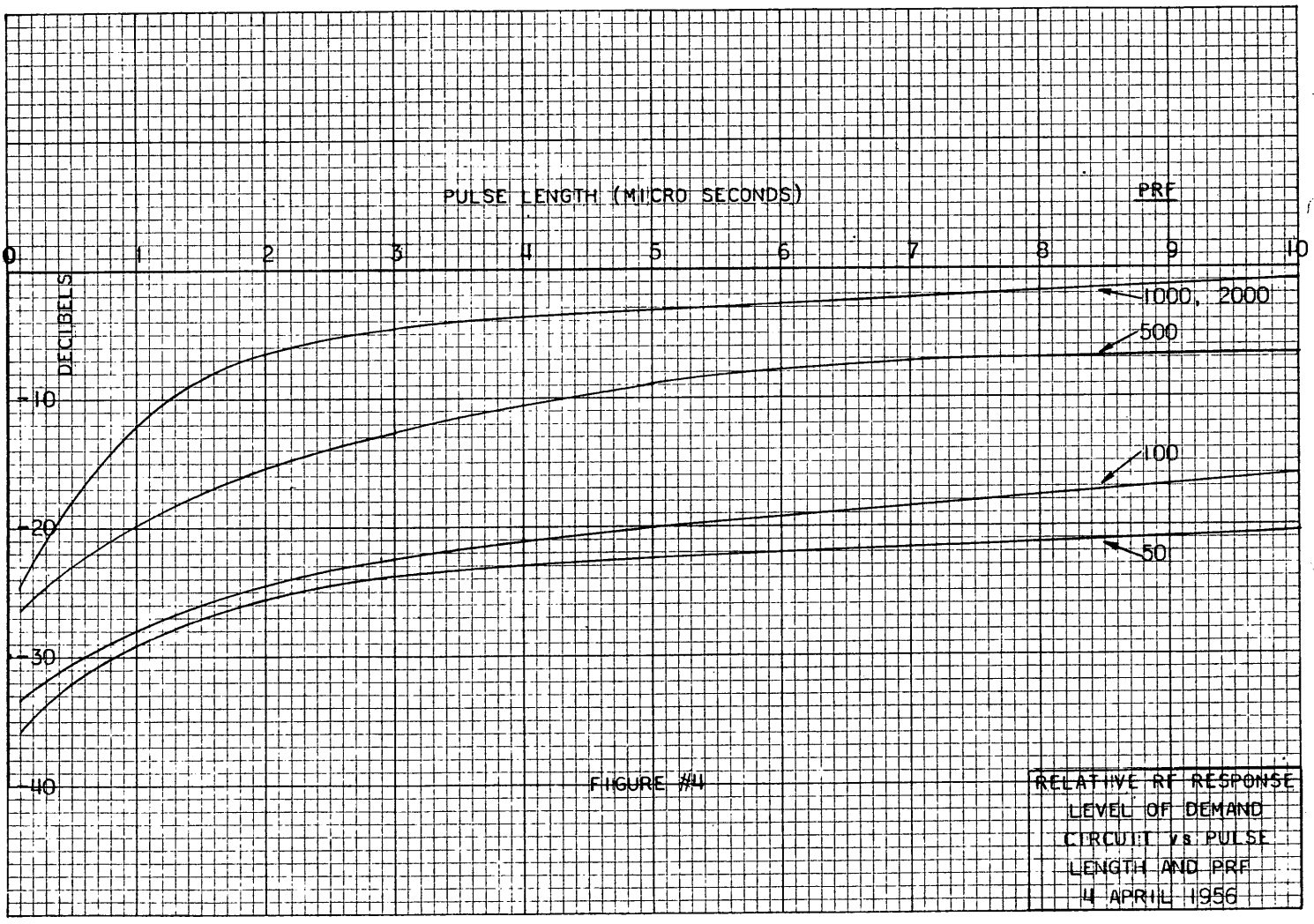

FIGURE #4

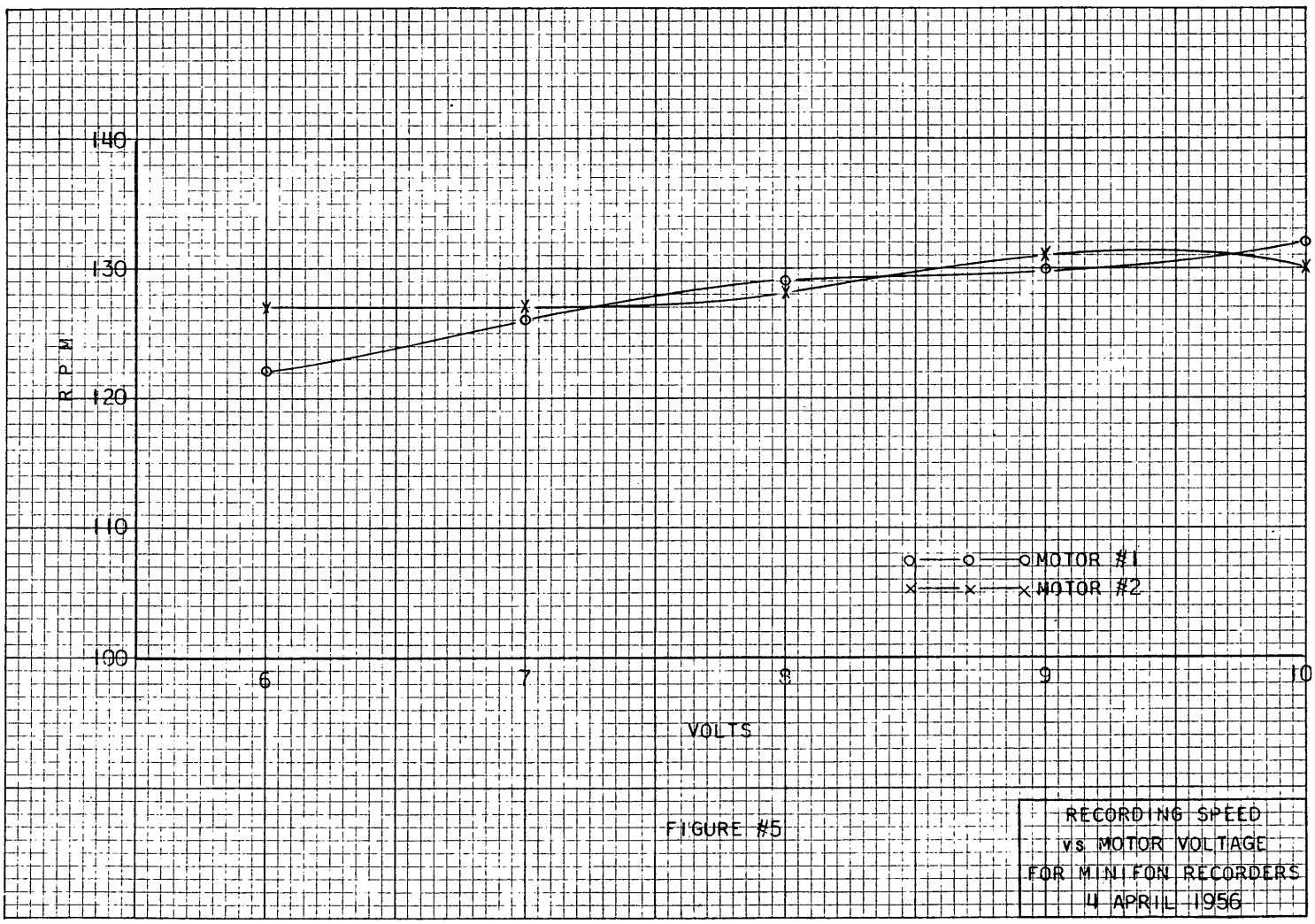

FIGURE #5

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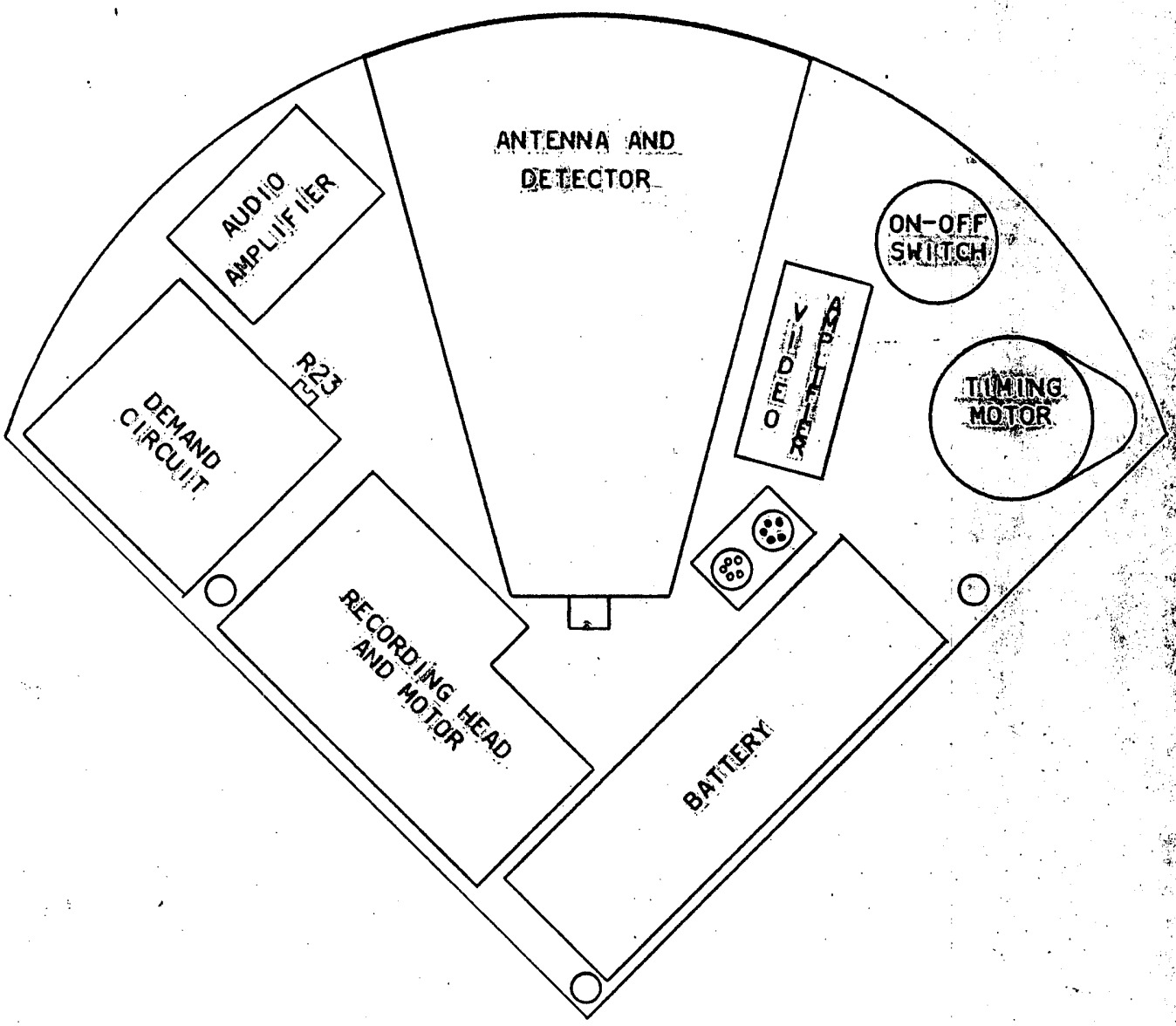

FLOOR PLAN

[redacted]

FIGURE #7

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APPENDIX

To General Application, Operating and Maintenance Instructions

YARDNEY ELECTRIC CORPORATION

40-46 Leonard Street
New York 13, N.Y.

OPERATING INSTRUCTIONS FOR YARDNEY SILVERCELS IN THE WET-FORMED CONDITION

Letters in parenthesis, refer to general reference table attached.....

CHARGE:

For best results, charge at a constant current rate of (A) until the cell/battery voltage, while charging, reaches (B) volts.

NOTE:

The voltage, **while charging,** is the indication of the state of charge of a cell or battery; however, nominal capacity of a fully discharged cell or battery may be obtained by charging at (A) current for (C) hours. Charging to the nominal capacity is not always a complete charge, and this method should not be used repeatedly.

CAUTION:

Continuous or repetitive overcharge will result in damage to the cell or battery.

LOW-RATE DISCHARGE: (For all type cells on one hour rate or longer time.)

An individual cell is considered discharged when its voltage under load drops to one volt. Cells assembled in a battery are considered discharged when the overall battery voltage under load drops below the number of cells in the battery multiplied by one volt.

HIGH-RATE DISCHARGE: (HR-V* and HR Cells only on less than one hour rates.)

When discharging at high rates, **discharge time limitations** should be observed or cells may overheat, resulting in distortion of cell cases and shortening of life. [redacted]

[redacted] of high and sub-normal rate cells or batteries are computed as follows:

[redacted] Discharge Time Limitations [redacted]

DISCHARGE CURRENT (Amperes) [redacted]

ELECTROLYTE – AS APPLICABLE FROM THE REFERENCE TABLE

If the electrolyte level of a cell is at the minimum height (D), immediately after charge, some distilled water should be added to bring the level to the correct height as shown in (E) of the reference table. The addition of distilled water, when required, may be accomplished by removing the plastic vent cap and the sponge rubber plug from the vent hole of the cell and adding water by means of a syringe. **Extreme caution** should be taken to prevent damage to the cell electrodes or separator by the tip of the syringe.

For additional information refer to General Application, Operating and Maintenance Instructions issued November 1953 – Technical Data Sheet No. 101

*FORMERLY DESIGNATED AS MR CELLS

SILVERCEL
REG. U.S. PAT. OFF.

February 1956

Sheet No. 2A

YARDNEY ELECTRIC CORPORATION

40-46 LEONARD STREET NEW YORK 13, N. Y.

GENERAL REFERENCE TABLE - (MEDIUM-RATE CELLS) (HIGH-RATE CELLS)

CELL TYPE MR = Medium Rate HR = High Rate	HR05	HR1	HR3	HR5	MR12	MR100	HR10	HR20	HR21	HR40	HR60	HR85	HR90	HR100
A*1 Optimum Current (Amperes) Single Cell	.07	.12	.40	.50	1.0	6	1.0	3.0	3.0	4	6	10	10	10
A*1 Optimum Current (Amperes) Battery	.07	.10	.30	.35	1.0	5	1.0	2.0	3.0	3	4	6	6	6
B*2 Maximum single cell voltage while charging	2.0	2.0	2.0	2.0	2.1	2.1	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
C Hours Single Cell	7	8	8	10	12	16	10	7	7	10	10	8	9	10
C Hours Battery	7	10	10	14	12	20	10	10	7	13	15	14	15	16
D*3 Minimum Level of electrolyte	¼	¼	¼	½	½	1	No additional electrolyte or distilled water is required during normal life of this type cell.							
E*3 Normal Level of electrolyte	½	¾	1"	1	1½	2								
F Time Limitation factor	1.0	2.0	4	8	12	100	10	20	25	40	60	85	90	100

*1 These current rates are generally based on a 10-20 hour charge. Cells may be charged at higher current rates whenever necessary. However, caution must be taken not to exceed the final voltage, while charging in B above, or an increase in cell temperature above 120-130°F during charge. A charging current of the one hour rate is permissible; for specific informations contact Manufacturer.

*2 Any battery is fully charged when its voltage, while charging, equals the number of cells in the battery multiplied by 2.0 volts. (Tolerance = ± 1.5% of the overall battery voltage)

*3 Electrolyte level heights (shown in (D) and (E) above) are measured in inches from the bottom of cells immediately after charge.

YARDNEY ELECTRIC CORP.
105-107 CHAMBERS STREET · NEW YORK 7 · N. Y.
Licensee for U.S.A. of Yardney International Corp.

1952 issue

Technical Data Sheet No. 1

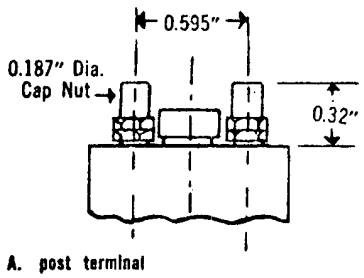
CELL MODELS LR05, HR05, LR1, HR1,

formerly A05 A1

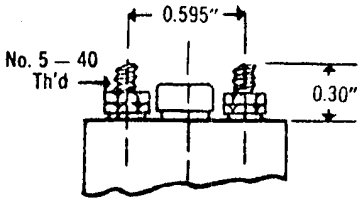
Cell Model	LR 05		HR 05		LR 1		HR 1	
Nominal capacity — amp.-hrs.	0.5		0.5		1.0		1.0	
Weight (filled)-oz.	0.72		0.72		1.00		1.00	
Volume — cu. in.*	0.92		0.92		1.16		1.16	
Recommended charging cur.-amp.	0.060		0.070		0.100		0.120	
Max. continuous disch. cur.-amp.	0.3		5		0.4		10	
Peak discharge current-amp.	25		30		35		45	
Discharge current-amp.	0.06	0.25	0.06	3	0.06	0.35	0.10	10
Voltage **	1.52	1.48	1.54	1.39	1.54	1.48	1.54	1.25
Working capacity — amp.-hrs. †	1.0	0.9	1.0	0.9	1.7	1.2	1.8	1.2
Watt-hrs. per lb.	33.8	29.6	34.2	27.8	41.9	28.4	44.4	24.0
Watt-hrs. per cu. in.*	1.65	1.45	1.68	1.36	2.26	1.53	2.39	1.29

*Calculated using cell heights inclusive of terminals
**Voltage over flat portion of the discharge curve
†To 1 volt end point

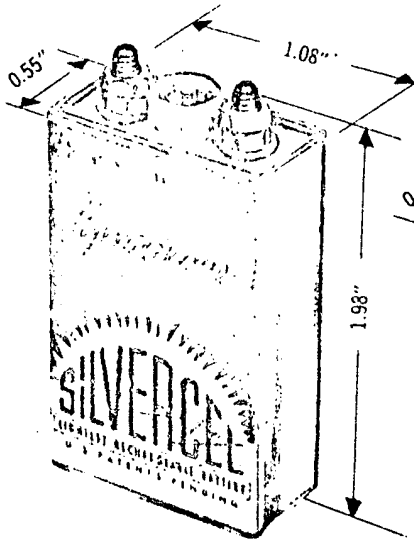
TERMINAL ARRANGEMENTS



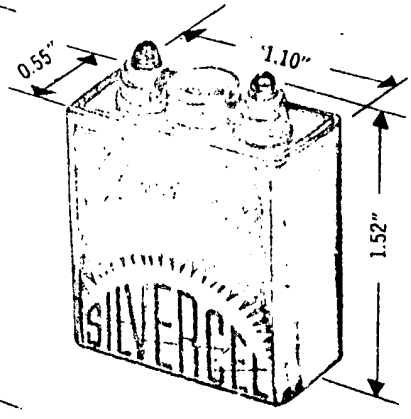
A. post terminal



B. stud and nut



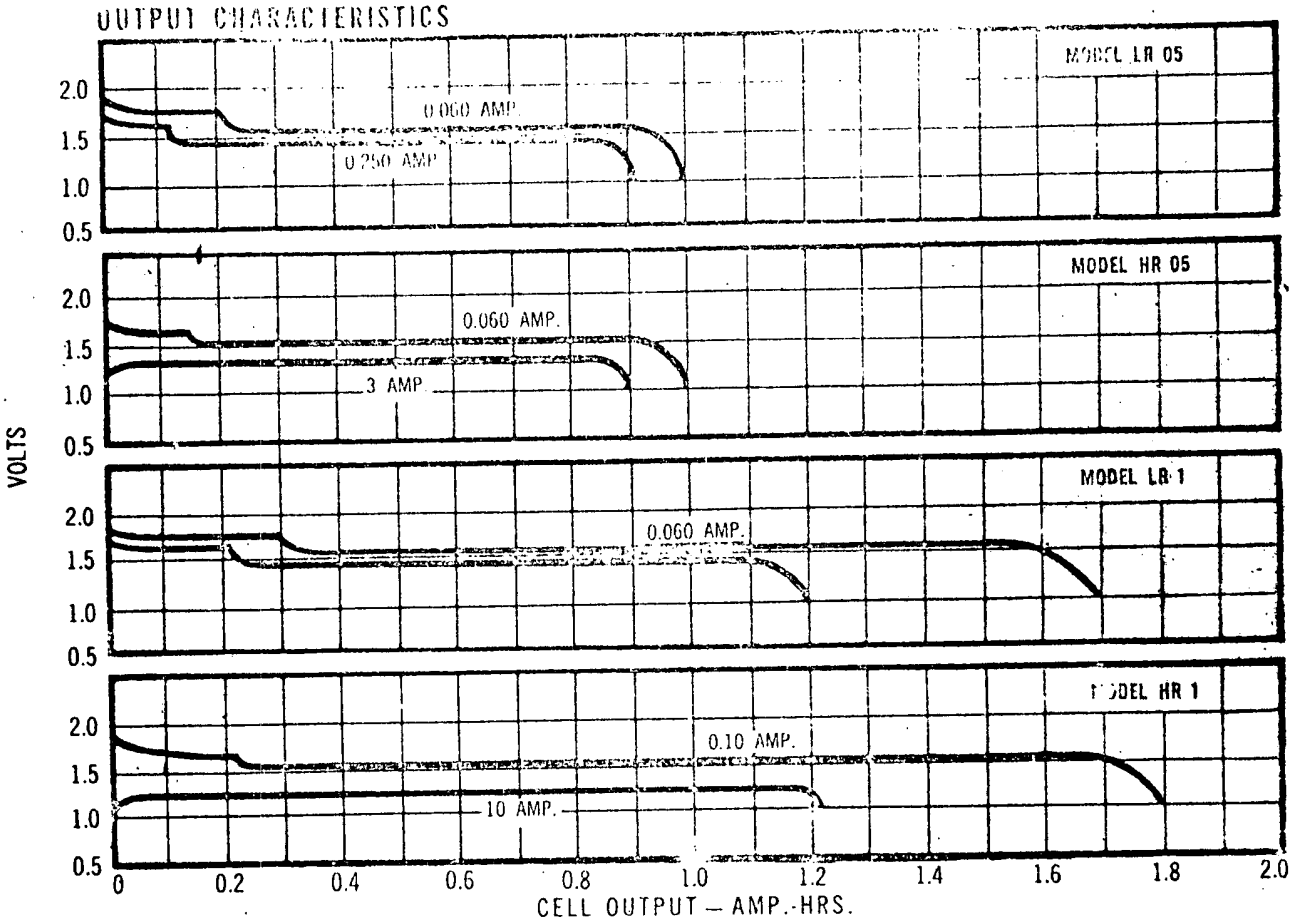
Model LR 1 and HR 1

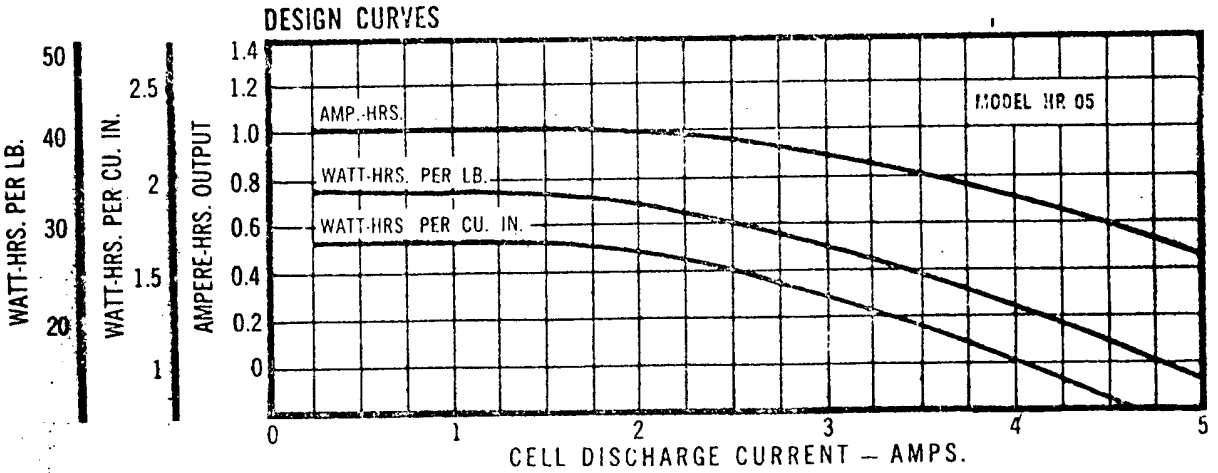


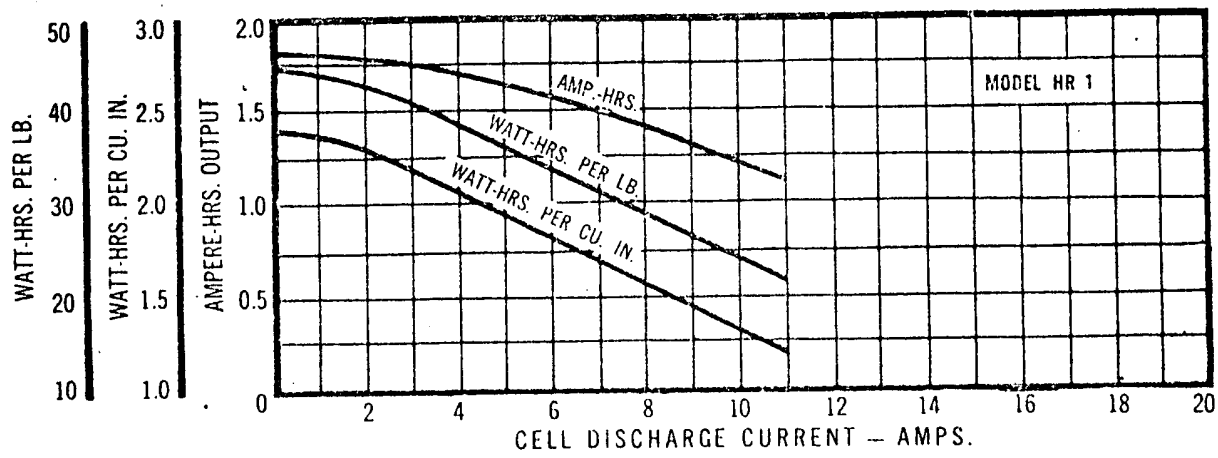
Model LR 05 and HR 05

For instructions on operation, maintenance, and storage see "General Operating and Maintenance Instructions for Yardney Silvercels."

WORLD WIDE PATENTS PENDING OR GRANTED







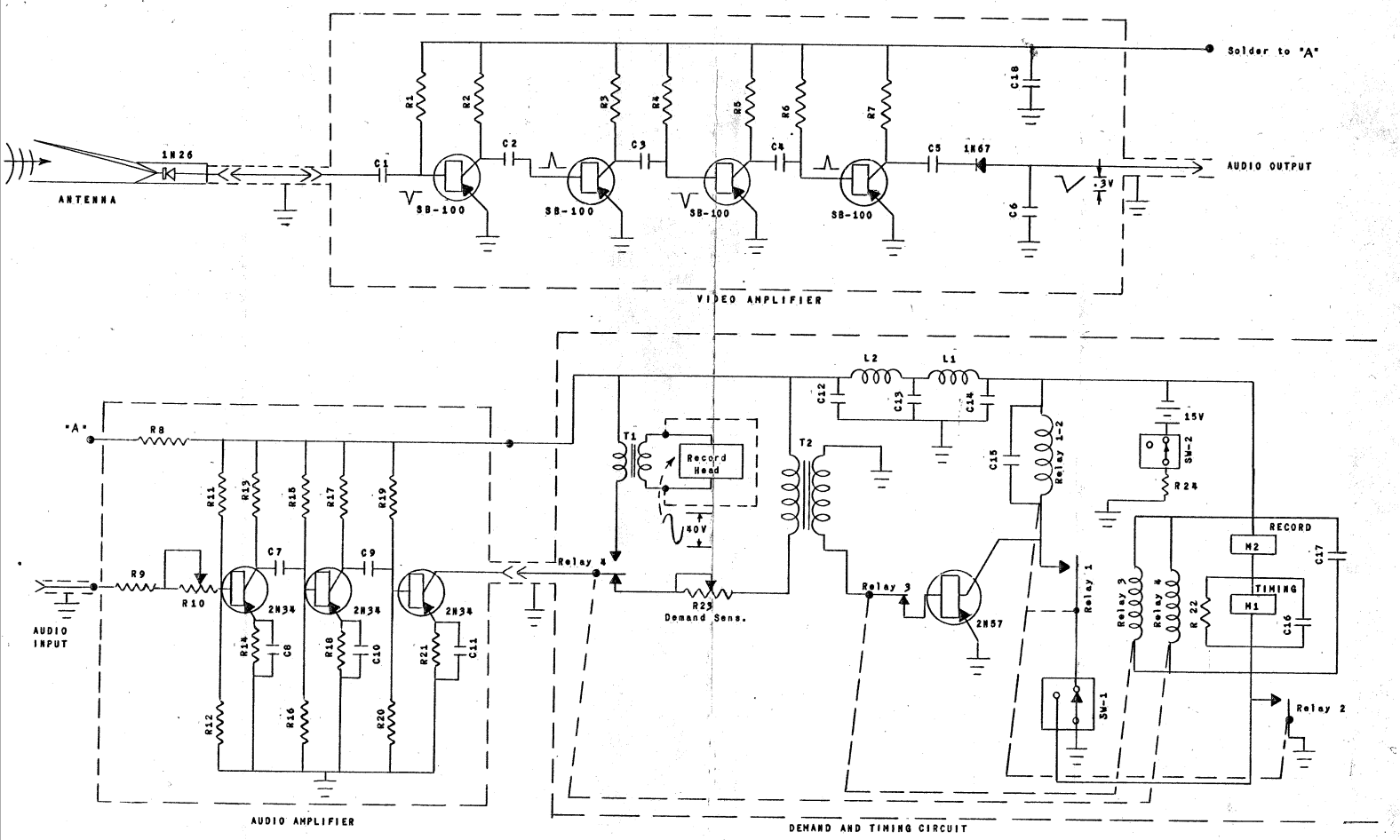


FIGURE 6

CIRCUIT DIAGRAM

20 April 1956

Charging instructions forwarded as ~~and an~~ addition to op note.

CHARGING INSTRUCTIONS FOR THE SILVERCEL BATTERY PACK

1. For best results, the Silvercel Battery Pack should be charged at a 100 milliampere rate for about 10 hours. However, if 10 hours cannot be allowed for the charging operation, the batteries can be charged at any intermediate rate up to a MAXIMUM of ONE AMPERE. The approximate charge time can be computed from a 1000 milliampere-hour base. Examples are:

	CHARGE RATE	APPROXIMATE CHARGE TIME
(a)	100 ma	10 hours
(b)	500 ma	2 hours
(c)	1000 ma	1 hour

The above rates and charge times are based on a fully discharged cell. Two precautions that must be observed are:

(a) The battery terminal voltage UNDER CHARGE should never be allowed to exceed 20 ± 0.3 volts.

(b) The cell temperature should not exceed 120 - 130°F. This factor will require close attention when charging at the higher rates.

2. The steps in the charging procedure are as follows:

(a) Connect the charging adaptor leads to the charging source — RED lead to PLUS and BLACK lead to MINUS. Monitor BOTH the battery voltage and the charging current.

(b) Connect the charging adaptor to the battery pack.

(c) Adjust the current to the desired charging rate. (100 ma is recommended)

(d) The charge time for a fully discharged battery is about 10 hours at the 100 ma rate. As the charging nears completion, the battery terminal voltage will approach 20 volts. When the terminal voltage is equal to 20 ± 0.3 volts, the battery is fully charged.

CONFIDENTIAL

(e) The battery can be PERMANENTLY DAMAGED by OVER CHARGING. The terminal voltage should be carefully watched as charging nears completion in order to insure that the terminal never exceeds 20 ± 0.3 volts.